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ABSTRACT

Improved methods and systems for controlling hydraulically or electrically actuated anti-lock brake systems (ABS) on air and land vehicles requiring only measurement of wheel angular speed although brake torque measurements can also be employed if available. A sliding mode observer (SMO) based estimate of net or differential wheel torque (road/tire torque minus applied brake torque) derived from the measured wheel speed is compared to a threshold differential wheel torque derived as a function of a "skid signal" also based on wheel speed only to generate a braking control signal. The braking control signal can be employed to rapidly and fully applying and releasing the brakes in a binary on-off manner and, as an additional option, possibly modulating the maximum available brake hydraulic pressure or electrical current when the brakes are in the "on" state in a continuous manner. In the case of the basic on-off component of braking, the brakes are released when the estimate of differential wheel torque is less than the threshold differential wheel torque (i.e. for relatively high values of brake torque), and the brakes are applied fully when the estimate of differential wheel torque is greater than or equal to the threshold differential wheel torque. For aircraft landing gear applications, a fore-aft accelerometer mounted on the landing gear can be used to suppress nonlinear gear displacement oscillations commonly called gear walk in the direction of wheel roll.